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PASTE COATING APPARATUS

[Abstract]

PROBLEM TO BE SOLVED: To facilitate the data setting for forming a paste pattern of a prescribed shape.

SOLUTION: For example, when four paste patterns P1-P4 applied and drawn on a substrate 22 have a pattern of have a, data (the coordinate position data of a basic pattern or vector data obtained by converting the segment data of the basic pattern) defining the basic pattern common to the paste patterns P1-P4 are set

and pattern data for applying and drawing the paste patterns P1-P4 are generated from t he data. In such a case, the data of a single basic pattern can be made the data of the paste patterns P1-P4 because the patterns have the same shape. However, the coating condition, or the like, has to be corrected at need because the applying and drawing positions of the paste patterns P1-P4 on the substrate 23 are different.

[Claims]

[Claim 1]

A paste coating apparatus in which a substrate is laid on a table in an opposing manner to a discharge outlet of a nozzle, and paste filled in a paste container box is discharged on the substrate from the discharge outlet of the nozzle while varying a relative positional relationship between the substrate and the nozzle in a direction parallel to the principle surface of the substrate according to set pattern data, whereby a paste pattern of a predetermined shape depending upon the pattern data is coated and patterned on the substrate, the paste coating apparatus comprising:

first setting means that sets data which define a basis pattern of the paste pattern to be coated and patterned;

second setting means that sets the data set in the first setting means as pattern data of a plurality of paste patterns that will be coated and patterned on the same substrate;

third setting means that sets a coating condition of every paste pattern to be coated and patterned, and allowing the coating condition to be modified; and

fourth setting means that sets a positional relationship in the substrate of a plurality of the paste patterns in which the pattern data are set in the second means,

wherein the plurality of the paste patterns is coated and patterned according to the positional relationship set in the fourth means, by coating the

paste according to a trace depending upon the pattern data on the substrate based on the coating condition.

[Claim 2]

The paste coating apparatus according to Claim 1, wherein the basis pattern consists of a plurality of base patterns, and the first setting means sets data that defines the base patterns every base pattern.

[Claim 3]

The paste coating apparatus according to Claim 1 or 2, wherein the data set in the first setting means are expressed into a coordinate location of a point on the basis pattern or a vector on coordinates of a segment of a line constituting the basis pattern.

[Title of the Invention]

Paste Coating Apparatus

[Detailed Description of the Invention]

[Field of the Invention]

The present invention relates to a paste coating apparatus, and more particularly, to setting of pattern data for coating a paste pattern having a predetermined shape by discharging paste from a nozzle on the principle surface of a substrate laid on a table.

[Description of the Prior Art]

In the paste coating apparatus, a paste pattern having a predetermined shape is formed on a substrate by changing a relative positional relationship between the substrate and a nozzle in a direction parallel to the principle surface of the substrate, while discharging paste filled in a paste container box from a discharge outlet of the nozzle on the substrate.

Conventionally, in setting pattern data indicating the relative positional relationship between substrate and the nozzle in a direction parallel to the principle surface of the substrate, coordinates of a relative motion path between the substrate and the nozzle are input every paste pattern.

Furthermore, a relative moving speed (hereinafter, referred to as "coating velocity") or a relative distance (hereinafter, referred to as "coating height"), between the nozzle and the substrate, the pressure applied to the paste container

box (hereinafter, referred to as "coating pressure"), and the like as a coating condition, are set every paste pattern.

[Problem(s) to be Solved by the Invention]

In the conventional paste coating apparatus, the shape or coating velocity, the coating height, the coating pressure, etc. are shown in each paste pattern. In the case where a plurality of patterns having the same shape and the same coating condition is formed on a sheet of a substrate, data have to be input as many as the pattern number. This makes a user inconvenient in inputting data.

Further, since one paste pattern has one coating condition (one coating velocity, one coating height, one coating pressure, etc.), it was difficult to set data for changing the coating condition (the coating velocity, the coating height, the coating pressure, etc.) in the middle of one paste pattern.

Accordingly, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a paste coating apparatus which facilitates setting of pattern data for forming a paste pattern having a predetermined shape.

[Means for Solving the Problem]

To achieve the above object, according to the present invention, there is provided a paste coating apparatus in which a substrate is laid on a table in an opposite way to a discharge outlet of a nozzle, and paste filled in a paste container box is discharged on the substrate from the discharge outlet of the nozzle while varying a relative positional relationship between the substrate and the nozzle in a direction parallel to the principle surface of the substrate

according to set pattern data, whereby a paste pattern of a predetermined shape depending upon the pattern data is coated and patterned on the substrate. The paste coating apparatus includes first setting means that sets data which define a basis pattern of the paste pattern to be coated and patterned, second setting means that sets the data set in the first setting means as pattern data of a plurality of paste patterns that will be coated and patterned on the same substrate,

third setting means that sets a coating condition every paste pattern to be coated and patterned, and allowing the coating condition to be modified, and fourth setting means that sets a positional relationship in the substrate of a plurality of the paste patterns in which the pattern data are set in the second means. In this case, the plurality of the paste patterns is coated and patterned according to the positional relationship set in the fourth means, by coating the paste according to a trace depending upon the pattern data on the substrate based on the coating condition.

[Embodiment of the Invention]

The present invention will now be described in detail in connection with preferred embodiments with reference to the accompanying drawings.

Fig. 1 is a view showing the construction of a paste coating apparatus according to an embodiment of the present invention. In Fig. 1, reference numeral 1 indicates a stand, 2a and 2b indicate substrate return conveyers, 3 indicates a support pole, 4 indicates a substrate adsorption plate, 5 indicates a θ -axis movement table, 6a and 6b indicate X-axis movement tables, 7 indicates a Y-axis movement table, 8a and 8b indicate servomotors, 9 indicates a Z-axis movement table, 10 indicates a servomotor, 11 indicates a ball screw, 12

indicates a servomotor, 13 indicates a paste container box (syringe) having a nozzle at its front end, 14 indicates a telemeter, 15 indicates a support plate, 16a and 16b indicate image recognition cameras, 17 indicates a controller. All of which constitute the body M of the apparatus. 18 indicates a monitor, 19 indicates a keyboard, 20 indicates a PC body having an external storage unit, 21a and 21b indicate cables, 22 indicates a glass substrate and 23 is a printer.

In Fig. 1, two substrate return conveyers 2a and 2b are disposed on the stand 1 so that they are parallel to each other in the X-axis direction and can ascend and descend. The substrate return conveyers 2a and 2b return a substrate (not shown) from the inside to the front in the drawing, i.e., in a parallel manner in the X-axis direction. Further, the support pole 3 is disposed on the stand 1. The substrate adsorption plate 4 is disposed on the support pole 3 with the θ -axis movement table 5 therebetween. The substrate 22 that is returned by the substrate return conveyers 2a and 2b is mounted on the substrate adsorption plate 4 and adsorbed thereto. The θ -axis movement table 5 serves to rotate the substrate adsorption plate 4 in the θ direction being Z axis rotation.

Furthermore, the X-axis movement tables 6a and 6b are disposed on the stand 1 parallel to the X axis at an outer side than the substrate return conveyers 2a and 2b. The Y-axis movement table 7 is disposed across the X-axis movement tables 6a and 6b. The Y-axis movement table 7 returns in a parallel manner in the X-axis direction according to rotation of forward rotation or backward rotation (forward and backward rotation) of the servomotors 8a and 8b disposed in the X-axis movement tables 6a and 6b.

The Z-axis movement table 9 that moves in the Y-axis direction as the ball screw 11 rotates in the forward and backward rotation directions according to the

driving of the servomotor 10 is disposed on the Y-axis movement table 7. The support plate 15 that supports and fixes the paste container box 13 or the telemeter part 14 is disposed on the Z-axis movement table 9. The servomotor 12 serves to the paste container box 13 or the telemeter part 14 in the Z-axis direction through a movable part of a linear guide (not shown) disposed on the support plate 15.

The paste container box 13 is mounted in the movable part of the linear guide in such a way to be detached from the movable part. Further, the image recognition cameras 16a and 16b for positioning, etc. of a substrate (not shown) are disposed upwardly on a ceiling plate of the stand 1.

The controller 17 that controls the servomotors 8a, 8b, 10, 12 and 24, a servomotor (not shown) for driving the θ -axis movement table 5, etc. is disposed within the stand 1. The controller 17 is connected to the monitor 18 or the keyboard 19 and the PC body 20 through the cable 21a. Data to be processed in the controller 17 are input from the keyboard 19, and an image captured by the image recognition cameras 16a and 16b or a processing situation in the controller 17 is displayed on the monitor 18.

Furthermore, information such as operation condition data such as coating shape data and coating condition data, which are input from the keyboard 19, and production management data such as production number that is transmitted from an external apparatus (not shown) is supplied to the PC body 20. In the PC body 20, this information is stored in an internal storage unit such as RAM or a built-in hard disk and an external storage medium such as floppy disk. Further, predetermined information is read from the storage media, according to a command by an operator, and then printed by the printer 23.

Fig. 2 is a block diagram showing the construction of the controller 17, an air pressure controller of the paste container box 13 and the substrate controller 22 shown in Fig. 1. In Fig. 2, 13a indicates the nozzle of the paste container box 13, 17a indicates a microcomputer, 17b indicates a motor controller, 17c1 and 17c2 indicate X1 and X2-axis drivers, 17d indicates a Y-axis driver, 17e indicates a θ -axis driver, 17f indicates a Z-axis driver, 17g indicates a data communication bus, 17h indicates an external interface, 24 indicates a servomotor that drives the θ -axis movement table 5 (Fig. 1), 25 to 29 indicate encoders, 30 indicates a positive pressure source, 30a indicates a positive pressure regulator, 31 indicates a negative pressure source, 31a indicates a negative pressure regulator and 32 indicates a valve unit. Like reference numerals are used to identify the same or similar parts as those of Fig. 1.

In Fig. 2, the controller 17 has the microcomputer 17a or the motor controller 17b, the X-, Y-, Z- and θ -axis drivers 17c1 to 17f, an image processing apparatus 17i that processes image signals obtained from the image recognition cameras 16a and 16b, and the external interface 17h that performs signal transmission together with the keyboard 19, etc. build in. The controller 17 further includes a driving control system of the substrate return conveyers 2a and 2b, which is not shown.

Further, the microcomputer 17a includes a main operation unit (not shown) or a ROM that stores a processing program for performing coating patterning of paste, which will be described later, a RAM that stores processing results in the main operation unit or input data from the external interface 17h and the motor controller 17b, an I/O unit that exchanges data with the external interface 17h or the motor controller 17b, and the like.

Each of the servomotors 8a, 8b, 10, 12 and 24 has the encoders 25 to 29, respectively. The servomotors 8a, 8b, 10, 12 and 24 perform positional control by returning the detection results to the X-, Y-, Z- and θ -axis drivers 17c1 to 17f.

A processing flow program for performing coating patterning of paste to be described later, which is stored in a ROM of the microcomputer 17a, can be modified through the cable 21a from the PC body 20, if needed. Furthermore, the processing flow program can be modified from a network (not shown) to which the PC body 20 is connected. However, the program body can be hidden so that it is not erroneously modified.

The substrate 22 is vacuum-adsorbed to the substrate adsorption plate 4(Fig. 1) by means of a partial pressure distributed from the negative pressure source 31. If the servomotors 8a, 8b and 10 rotate in a forward or backward direction on the basis of data that are input from the keyboard 19 and then stored in the RAM of the microcomputer 17a, the Z-axis movement table 9 moves in the X- and Y-axis direction. Accordingly, the nozzle 13a of the paste container box 13 mounted in the Z-axis movement table 9 is kept from the substrate 22 with a predetermined distance therebetween in the Z-axis direction, and moves in X- and Y-axis direction. The motion trace in a plane (XY plane) parallel to the principle surface of the substrate 22 of the nozzle 13a is decided by the data. During the movement, as the microcomputer 17a controls the valve unit 32, some air pressure is applied from the positive pressure source 30 to the paste container box 13 through the positive pressure regulator 30a and the valve unit 32. Thus, paste is discharged from the discharge outlet of the front-end portion of the nozzle 13a and is then coated on the substrate 22 in a desired pattern.

While the Z-axis movement table 9 moves in a parallel way to the X and Y-axis direction, the telemeter 14 measures a distance (coating height) between the paste discharge outlet of the nozzle 13a and the substrate 22, and the servomotor 12 is controlled by the Z-axis driver 17f in such a way that the distance always keeps constant.

Further, in a standby state where the paste is not coated, since the microcomputer 17a controls the valve unit 32, the negative pressure source 31 communicates with the paste container box 13 through the negative pressure regulator 31a and the valve unit 32, and the paste discharged from the paste discharge outlet of the nozzle 13a is retuned to the paste container box 13. It is thus possible to prevent paste from leaking from the discharge outlet. Further, the paste discharge outlet of the nozzle 13a is monitored by an image recognition camera (not shown). Thus, only when leakage is generated, the negative pressure source 31 can communicate with the paste container box 13.

Fig. 3 is a flowchart illustrating the entire process of a paste coating (patterning) process of the embodiment shown in Fig. 1.

In Fig. 3, if power of the PC body 20 connected to the paste coating apparatus is applied (Step 100), a paste pattern data setting process is executed (Step 200).

One or more paste patterns are coated on a substrate (hereinafter, referred to as "real substrate") 22 being the subject of a target paste pattern. In the paste pattern data setting process (Step 200), a variety of data, such as data every paste pattern (hereinafter, referred to as "paste pattern data") or position data of the real substrate 22, a relative speed between the real substrate 22 and the nozzle 13a when the paste is actually coated on the real substrate 22 (this is referred to as

"coating velocity", and more particularly, the coating velocity in this case is referred to as "initial setting coating velocity"), the height of the paste discharge outlet of the nozzle 13a from a surface of the substrate 22 (this is referred to as "coating height", and more particularly, the coating height in this case is referred to as "initial setting coating height"), the pressure applied to the paste container box 13 (this is referred to as "coating pressure", and more particularly, the coating pressure in this case is referred to as "initial setting coating pressure"), which decide the paste discharge amount from the nozzle 13a are set. The input of these data is performed through the keyboard 19 (Fig. 1), and the input data are stored in the RAM within the PC body 20.

Fig. 4 is a flowchart illustrating a detailed example of the paste pattern data setting process (Step 200). In this case, a case where paste of eight paste patterns 23a to 23h having the shape shown in Fig. 5 is coated on the real substrate 22 will be described. However, the four paste patterns 23a, 23c, 23e and 23g have the same shape, size and dimension. These patterns are called the pattern of the same shape. Furthermore, the other four paste patterns 23b, 23d, 23f and 23h have the same shape. Further, the paste patterns 23a and 23b form a pair to form a paste pattern P1, the paste patterns 23c and 23d form a pair to form a paste pattern P2, the paste patterns 23e and 23f form a pair to form a paste pattern P3, and the paste patterns 23g and 23h form a pair to form a paste pattern P4.

Accordingly, these paste patterns P1 to P4 have the same shape, and the basis pattern BP is shown in Fig. 6. At this time, the basis pattern BP consists of the two base patterns BP1 and BP2, which can be drawn once. The base pattern BP1 is a basis pattern of the paste patterns 23a, 23c, 23e and 23g of Fig. 5, and

the base pattern BP2 is a basis pattern of the paste patterns 23b, 23d, 23f and 23h of Fig. 5 (R>5).

In the base data setting process (Step 201) of Fig. 4, the basis pattern BP shown in Fig. 6 of the paste patterns P1 to P4 that will be actually formed is first written, and data of the basis pattern BP is set (input). Before data of the basis pattern BP are set, a user writes a registration item table MDT regarding these patterns shown in Fig. 7 since he or she knows the paste patterns P1 to P4 or their basis pattern BP that will be coated on the real substrate 22. Data registered with the registration item table MDT are the paste patterns P1 to P4 shown in Fig. 5. If taking the basis pattern BP shown in Fig. 6 as an example, 「the number of patterns」 is the number of paste patterns coated on the real substrate 22. In this case, since the paste patterns P1 to P4 is four, the number of patterns is 4. 「The number of base data」 is the number of base patterns constituting each of the paste patterns P1 to P4, i.e., the number of the base patterns constituting the basis pattern BP. In this case, the number of base data is two since it is the base patterns BP1 and BP2. 「The number of vectors」 is vector of a straight portion constituting the basis pattern BP, as will be described later, and is the number of vectors (i.e., the number of straight portions). The number of vectors is set in each of the base patterns BP1 and BP2 of the basis pattern BP. Further, the number of base data is allocated to each of the base patterns of the basis pattern BP. In case of Fig. 6, the number of base data 1 and 2 is allocated to the base patterns BP1 and BP2 of the basis pattern BP, respectively. The number of vectors of 「the number of base data 1」 from the number of straight portions is 7, and the number of vectors of 「the number of base data 2」 is 3.

Furthermore, as the registration item table MDT is set, a vector data table

MVDT shown in Fig. 8 is prepared by means of the microcomputer 17a(Fig. 2). The vector data table MVDT is prepared every pattern coated on the real substrate 22 on the basis of data of the registration item table MDT. In this case, a pattern to be coated on the real substrate 22 is decided based on 「the number of patterns」 and 「the number of base data」 from the registration item table MDT. Accordingly, a prepared vector data table MVDT is decided. In case of Figs. 5 and 6, since 「the number of patterns」 in the registration item table MDT is 4 and 「the number of base data」 is 2, the number of patterns coated on the real substrate 22 becomes 8 (=4×2). Eight vector data tables MVDT are prepared, and every two of them are allocated to each of the paste patterns P1, P2, P3 and P4. Further, among the two vector data tables MVDT allocated to each of the paste patterns, one of the two vector data tables MVDT is allocated to base data BD1 of the base pattern BP1 of one of the basis patterns BP, and the other of the two vector data tables MVDT is allocated to the base data BD2 of the base pattern BP2 of the other of the basis patterns BP. In this case, the vector data table MVDT of the base data BD1 corresponds to the number of base data 1 in the registration item table MDT, and the vector data table MVDT of the base data BD2 corresponds to the number of base data 2 in the registration item table MDT.

Further, items regarding allocated patterns are set in each vector data tables MVDT. That is, a storage unit that stores data of 「a x component」 or 「a y component」 of vector, a storage unit that stores the dimension of a corner (the radius of curvature) r of a base pattern, or a storage unit that stores data of a coating condition (a setting coating velocity, a setting coating pressure and a setting coating height) is disposed every vector number to be described later. The number of vectors is decided as 「the number of vectors」 of 「the number

of base data」 in the registration item table MDT every vector data table MVDT. Further, since the dimension of the corner r or the coating condition can be decided in advance, they are input after the vector data table MVDT is prepared.

As such, if the registration item table MDT is set, each vector data table MVDT is automatically prepared. In the real substrate 22 shown in Fig. 5, base data regarding the paste patterns P1 to P4 for coating patterning are set (Step 201). In this case, the base data are not set every paste patterns P1 to P4, but base data regarding the basis pattern BP shown in Fig. 6 of the paste patterns P1 to P4 are set.

At this time, in the basis pattern BP shown in Fig. 6, it is assumed that G0 is a starting point, and the ends of each of the base patterns BP1 and BP2 for the starting point G0 and a location of each curved portion (corresponding to the corner of the paste patterns P1 to P4 of Fig. 5) are points A1, A2, A3, ..., A8, and points B1, B2, B3, B4 sequentially from these ends. Further, in the case where paste is coated, in the base pattern BP1, the location A1 is set to the coating start point and the location A8 is set to the coating end point. Moreover, in the base pattern BP2, the location B1 is set to the coating start point and the location B4 is set to the coating end point.

In data (base data) of the basis pattern BP, when G0 is the starting point, the points A1 to A8 are directly designated in positional coordinates of An(xan, yan). Further, the locations B1 to B4 are directly designated in positional coordinates of Bm(xbm, ybm). In the case of Fig. 6, however, n=1, 2, ..., 8, m=1, 2, 3, 4. At this time, in the case of the basis pattern BP shown in Fig. 6, positional coordinate data of each of the points A1 to A8, B1 to B4 are A1(xa1, ya1), A2(xa2, ya2), A3(xa3, ya3), ..., A8(xa8, ya8), the points B1(xb1, yb1), B2(xb2, yb2),

B3(xb3, yb3), B4(xb4, yb4).

Furthermore, if a pattern is complicated, the positional variables n and m are extended, or the number of the base patterns increases.

These positional coordinate data are registered with the positional coordinate data table BDT provided in the RAM built in the PC body 20 (Fig. 1 R>1), corresponding to the points A1 to A8 and the points B1 to B4 (the first setting means). Fig. 9 shows a detailed example of the table. Fig. 9(a) shows a positional coordinate data table BDT1 of the base pattern BP1, and Fig. 9 (b) shows the positional coordinate data table BDT2 of the base pattern BP2.

The above process is the base data setting process (step 201) in Fig. 4. If this process is finished, the process proceeds to a relative vector conversion process (step 202) in which the straight portion (a segment of a line) of each of the base patterns BP1 and BP2 is expressed into a vector having a direction and size (length).

The basis pattern BP is shown as the base patterns BP1 and BP2 in which the straight line is basic, as shown in Fig. 6. By vectoring a segment of a line (the straight portion) between the positional coordinates, it can be expressed into a direction along which paste of the segment of the line is coated and a distance thereof. As such, a process of converting the segment of the line of the basis pattern BP into vector based on data of the positional coordinate data table BDT shown in Fig. 9 is the relative vector conversion process (step 202). This process will be below described.

Vector numbers a1, a2,..., an-1 (in Fig. 6, n=8) are sequentially set to vectors that set the segment of the line between locations A1-A2 and between A2-A3,..., of the base pattern BP1 shown in Fig. 6. A vector component, i.e., the

amount of the vector (a distance between positional coordinates), a component (the x component) Δxi of a X-axis direction and a component (the y component) Δyi (where, i=1, 2, ..., n-1) of a Y-axis direction are found based on positional coordinate data of the positional coordinate data table BDT1 shown in Fig. 9(a) every vector number. For example, the vector component for the segment of the line between A1-A2 is $\Delta x1=xa2-xa1$ $\Delta y1=ya2-ya1$. As such, the vector components (Δxi, Δyi) every vector number ai, which are obtained for the base pattern BP1, are registered with the vector data table VDT1 shown in Fig. 10(a).

In the same manner, regarding the base pattern BP2 shown in Fig. 6, vector numbers b1, b2, ...bm-1 (in Fig. 6, m=4) are sequentially set to vectors that set the segment of the liens between B1-B2, B2-B3,... The vector components Δxj ad Δyj (where, j=1, 2, ..., m-1) are found every vector number based on positional coordinate data of the positional coordinate data table BDT2 shown in Fig. 9(b). As such, the vector components (Δxj, Δyj) every vector number bj, which are obtained for the base pattern BP2, are registered with the vector data table VDT2 shown in Fig. 10(b).

The above process is the relative vector conversion process (step 202) in Fig. 4. This process is performed after it is determined whether the base data have been set and registered (step 203). This determination is automatically performed base on data of the registration item table MDT shown in Fig. 7. That is, "the number of base data" is 2 in the registration item table MDT. As shown in Fig. 10, the two vector data tables VDT are written. It is determined whether the number of vectors becomes "the number of vectors"=7, which is set in the registration item table MDT, in the vector data table VDT1 (Fig. 10(a)) for "the number of base data 1", and the number of vectors becomes "the number of

vectors"=3, which is set in the registration item table MDT, in the vector data table VDT1(Fig. 10(b)) for "the number of base data 2". If the two conditions are fulfilled, it is determined that registration of the base data is finished. If there is error in the number of base data input in setting of the base data (step 201) or one of the vector data tables VDT1 and VDT2 is not fulfilled, the base data are not registered, and the process returns to step 201. In this case, positional coordinate data in the basis pattern BP shown in Fig. 6 are input as base data again, and the positional coordinate data table BDT shown in Fig. 9 is set.

Furthermore, in Fig. 4, the steps 201 to 203 are sequentially performed on the base patterns BP1 and BP2. Accordingly, the steps 201 to 203 are repeatedly performed as many as the number as the number of the base patterns (i.e., 2). Whether the registration of the base data has been finished is conformed in each of the base patterns BP1 and BP2 in the step 203. The base data setting process (step 201) is performed on the entire base patterns. The positional coordinate data tables BDT of the entire base patterns are written. The step 202 is performed on each of the positional coordinate data tables BDT. The vector data table VDT is written in order of the base patterns. In this case, after the vector data table VDT of all the base patterns is written, the confirmation process of the step 203 is performed.

Furthermore, the vector data table VDT shown in Fig. 10 is written based on data of the positional coordinate data table BDT shown in Fig. 9. A vector component for each segment of a line is obtained from the base pattern of the reference pattern BP. The vector component can be directly input on the vector data tables VDT1 and VDT2.

As such, if the base data registration confirmation process (step 203) is

finished, the vector data table VDT having the same number as the number of the base patterns is registered with the RAM of the PC 20. As soon as such registration is confirmed, the vector components(Δ xi, Δ yi) of each of the vector numbers of the vector data table VDT1 are written into the vector data table MVDT for the base data BD1 of the pattern data P1 shown in Fig. 8, which are prepared, as described above. The written vector components (Δ xi, Δ yi) are automatically recognized in the vector data table MVDT for the base data BD1 of other paste patterns P2, P3 and P4. By doing so, the vector components (Δ xj, Δ yj) of each vector number of the vector data table VDT2 are written into the vector data table MVDT for the base data BD2 of the pattern data P1 shown in Fig. 8. The written vector components (Δ xj, Δ yj) are automatically recognized in the vector data table MVDT for the base data BD2 of other paste patterns P2, P3 and P4. Accordingly, the vector components (Δ xi, Δ yi) of each vector number of the same vector data tables VDT1 are stored in the vector data table MVDT for the base data BD1 of the paste patterns P1, P2, P3 and P4. The vector components (Δ xj, Δ yj) of each vector number of the same vector data tables VDT2 are stored in the vector data table MVDT for the base data BD2 of the paste patterns P1, P2, P3 and P4.

Furthermore, data such as the dimension of a corner r or a coating condition, which are previously set, are also stored in the vector data table MVDT for BD1 of the paste pattern P1. The stored data are automatically recognized in other vector data tables MVDT. Accordingly, data of the same dimension of a corner r or the same coating condition are stored in all the vector data tables MVDT.

Furthermore, in each of the paste patterns 23a to 23h shown in Fig. 5, a

connection unit of the straight portion, i.e., a corner (a portion corresponding to the locations A2 to A7, B2, B3 in the basis pattern BP) is rounded. Therefore, no only the corners are made smooth, but also variation in a relative position between the nozzle 13a and the substrate 22 at this portion becomes smooth. That is, mechanical vibration causing an abrupt speed change in the corner in the paste patterns 23a to 23h is reduced, and the coating velocity can become fast accordingly. Therefore, it is possible to not only improve the productivity, but also to reduce generation of defective substrates due to defective shapes of a paste pattern, which is caused by vibration.

Meanwhile, the basis pattern BP shown in Fig. 6 consists of only a straight portion. In order to perform the rounding process of a predetermined radius r on the corner of the paste patterns 23a to 23h that will be actually coated and patterned in the real substrate 22, the dimension of the corner r data is input as described above, and is registered with the vector data table MVDT, as shown in Fig. 8. Accordingly, in the event that the paste patterns 23a to 23h are coated and patterned in the real substrate 22 using the vector data table MVDT, the PC body20 automatically connects the straight portion by the x component or the y component of each vector to an overlapping location on the circumference of the radius r by means of the dimension of the corner r data.

After the process is performed, a next process, i.e., a group data setting process (step 204) is performed.

In this case, the paste patterns 23a and 23b constituting the paste pattern P1 in Fig. 5 form one group (pair). In the same manner, the paste patterns 23c and 23d constituting the paste pattern P2, the paste patterns 23e and 23f constituting the paste pattern P3, and the paste patterns 23g and 23h constituting the paste

pattern P4 form one group. The group data setting process (step 204) is to set the data (i.e., group data) indicating a positional relationship between the paste patterns constituting the group.

The base patterns BP1 and BP2 in the basis pattern BP shown in Fig. 6 are set as group data for the paste patterns P1 to P4. Further, the group data indicting the positional relationship between the base patterns BP1 and BP2 are expressed into the relative positional relationship of the beginning of the base patterns BP1 and BP2 for the starting point GO of the basis pattern BP (corresponding to the coating start point of the paste pattern shown in Fig. 5) with reference to Fig. 6.

The group data setting process (step 204) includes inputting and setting data indicating the relative positional relationship. If the data are input, they are registered with the relative positional relationship table BPRPT shown in Fig. 11, which are set in the RAM of the PC body20 in a next group data registration process (step 205).

In this case, in the relative positional relationship table BPRPT, "the number of the base data BD1" indicates the base pattern BP1 in the basic data BP of Fig. 6. "The relative position" Bx, By indicate the x component and the y component (therefore, the relative positional relationship) of a distance between the starting point GO in Fig. 6 and the beginning A1 of the base pattern BP1. In the same manner, "the number of the base data BD2" indicates the base pattern BP2 in the basic data BP of Fig. 6. "The relative positions" Bx, By indicate the x component and the y component (therefore, the relative positional relationship) of a distance between the starting point GO in Fig. 6 and the beginning B1 of the base pattern BP2.

Furthermore, "the relative positions" Bx, By of "the number of the base data BD1" indicate a relative positional relationship of two paste patterns constituting the paste patterns P1, P2, P3 and P4 every paste patterns P1, P2, P3 and P4 in the real substrate 22 shown in Fig. 5. That is, "the relative positions" Bx, By indicate a x component and a y component of a distance between central locations (x1, y1) of the paste pattern P1 and a coating start point of the paste pattern 23a in the paste pattern P1, a x component and a y component of a distance between central locations (x2, y2) of the paste pattern P2 and a coating start point of the paste pattern 23c in the paste pattern P2, a x component and a y component of a distance between central locations (x3, y3) of the paste pattern P3 and a coating start point of the paste pattern 23e in the paste pattern P3, and a x component and a y component of a distance between central locations (x4, y4) of the paste pattern P4 and a coating start point of the paste pattern 23g in the paste pattern P4, respectively.

In the same manner, "the relative positions" Bx, By of "the number of base data BD2" indicate a x component and a y component of a distance between central locations (x1, y1) of the paste pattern P1 and a coating start point of the paste patterns 23b in the paste pattern P1, a x component and a y component of a distance between central locations (x2, y2) of the paste pattern P2 and the coating start point of the paste pattern 23d in the paste pattern P2, a x component and a y component of a distance between central locations (x3, y3) of the paste pattern P3 and the coating start point of the paste pattern 23f in the paste pattern P3, and a x component and a y component of a distance between central locations (x4, y4) of the paste pattern P4 and the coating start point of the paste pattern 23h in the paste pattern P4.

Whether these group data have been successfully registered or not is determined depending upon whether the data have been registered every number of base data BD1 and BD2 of the relative positional relationship table BPRPT (Fig. 11), and data of "the number of base data" of the registration item table MDT shown in Fig. 7. In the case of the basis pattern BP shown in Fig. 6, since "the number of base data" of the registration item table MDT is 2, if two group data are registered with the relative positional relationship table BPRPT, it is determined that registration of the group data is completed. If the remaining base patterns for which setting of group data is not completed remain, the process of the steps 204 and 205 is repeated every base pattern in order to set and register group data for the remaining base patterns.

If the group data registration process is finished, the process proceeds to the pattern data setting process (step 207). This process includes defining the positional relationship of the paste patterns P1, P2, P3 and P4 on the real substrate 22. The positional relationship can be expressed into a relative positional relationship between the starting point of the real substrate 22a and the central location of the paste patterns P1, P2, P3 and P4.

The pattern data setting process (step 207) includes inputting and setting data indicating a relative positional relationship (this will be referred to as "pattern data"). If the data are input, they are registered with the relative positional relationship the table MPRPT shown in Fig. 12, which is set in the RAM of the PC body 20, in a next pattern data registration process (step 208).

In this case, in the relative positional relationship table MPRPT, "the pattern numbers P1, P2, P3 and P4" are numbers allocated to the paste patterns P1, P2, P3 and P4, respectively, in Fig. 5. The "relative positions" Px, Py indicate a x

component and a y components of a distance (therefore, a relative positional relationship) between the starting point SBO of the real substrate in Fig. 5 (its coordinate locations are (0, 0)) and the central locations (x1, y1), (x2, y2), (x3, y3) and (x4, y4) of the paste patterns P1, P2, P3 and P4.

In a next pattern data registration end process (step 209), whether registration of the pattern data has been successfully completed is determined depending upon whether the pattern data have been registered every the pattern numbers P1, P2, P3 and P4 if the relative positional relationship table MPRPT (Fig. 12), and using data of "the number of patterns" of the registration item table MDT shown in Fig. 7 (R>7), which is previously set. If paste patterns that are coated and patterned on the real substrate 22 are four paste patterns P1, P2, P3 and P4 shown in Fig. 5, it is determined that registration of the pattern data is completed since "the number of patterns" of the registration item table MDT is 4 if the four pattern data are registered with the relative positional relationship table MPRPT. If the remaining paste patterns with which the pattern data are not registered exist, the processes of the steps 207 and 208 are repeatedly performed on the paste patterns in order to set and register the pattern data for the remaining coating patterns.

By doing so, if the pattern data for the entire paste patterns are set and registered (step 209), the process proceeds to a next entire data test registration process (step 210). Data of each of the tables registered with the RAM of the PC body 20 are made into text data that can be edited using a given text editor so that these operation conditions can be reused in next operations. The data stored in an external storage unit of the PC body 20 are then stored in a storage media such as a floppy disk.

Furthermore, in the entire data test registration process (step 210), before the data are stored as the text data, an obtained vector data table MVDT (Fig. 8) or a relative positional relationship table BPRPT (Fig. 11 R>1) and MPRPT (Fig. 12) are displayed on the monitor 18 (Fig. 1) so that registered contents can be confirmed. In this case, if it is desired to change registered contents of a predetermined paste pattern (e.g., the corner r of the dimension, a coating condition, etc.), the registered contents can be modified by inputting desired data using the keyboard 19 (Fig. 1).

Furthermore, if data are registered in steps 203, 206 and 209, the registered data are displayed on the monitor 18 so that they can be confirmed. Further, the registered data can be modified using the keyboard 19.

As described above, not only data of the obtained paste pattern can be readily reused as data based, but also the shape of a paste pattern or a coating condition that employ the base data can be modified in a batch mode by modifying the base data. If it is desired to modify only a specific paste pattern, data of the specific paste pattern can be readily modified by specifying and changing a registration name of the base data.

Further, as such, operation data are stored in an additional storage media separately from the RAM of the PC body 20. Paste pattern data registered with the storage media can be confirmed and modified and next operation data can be written, regardless of the state of an apparatus body M (during operation or stop). Accordingly, the productivity in writing data can be improved, and paste pattern data can be edited or an operating condition of the device body M can be managed in a remote manner through a network (not shown).

Further, text data registered with the storage media such as the floppy disk

can be edited and the paste pattern data can be written. The data can be easily written using application programs such as CAD application, table calculation application and a database application in addition to a general-purpose word processor.

In Fig. 3, if the paste pattern data setting process (step 200) is finished, power is applied to the paste coating apparatus (step 300) and initial setting is thus executed (step 400).

In the initial setting process (step 400), the Z-axis movement table 9 is moved in the X and Y direction by driving the servomotors 8a, 8b and 10 and is positioned at a predetermined reference location, in Fig. 1. The nozzle 13a (Fig. 12) is positioned at a predetermined starting point so that it is located at a location where the paste discharge outlet begins discharging paste (i.e., a paste coating start point).

Furthermore, a coating data transmission process between the PC body 20 and the device body M is automatically performed. While previously set pattern data, etc. are set as operating data in the RAM of the controller 17 of the device body M, they are recorded in a storage media (not shown) of the controller 17.

If the initial setting process (step 400) is finished, the real substrate 22 is mounted in the substrate adsorption plate 4 (Fig. 1) and adsorbed thereto (step 500). In the process of mounting the substrate (step 500), the real substrate 22 is returned to the top of the substrate adsorption plate 4 in the X-axis direction by means of the substrate return conveyers 2a and 2b (Fig. 1), and the substrate return conveyers 2a and 2b are lowered by means of an elevator (not shown). Thus, the real substrate 22 is mounted in the substrate adsorption plate 4.

A substrate preliminary positioning process (step 1500) is then performed.

In this process, X and Y directions of the real substrate 22 are positioned by means of a positioning chuck (not shown), in Fig. 1. Further, an image of a positional mark of the real substrate 22 mounted in the substrate adsorption plate 4 is taken by the image recognition cameras 16a and 16b, and a centroid position of the positional mark is then found through an image process, thereby detecting a tilt in a θ direction of the real substrate 22. The servomotor 24 (Fig. 3) is driven based on the centroid position, thus correcting the tilt of the θ direction.

The process proceeds to a pattern coating process (step 700). In this process, a paste pattern coating patterning operation is carried out using data, such as the vector data table MVDT (Fig. 8), which is stored in the RAM of the PC body 20, the relative positional relationship table BPRPT (Fig. 11), and the relative positional relationship table MPRPT (Fig. 12) in order to pattern numbers of paste patterns, e.g., in order of the paste patterns P1, P2, P3 and P4. In this process, the discharge outlet of the nozzle 13a is located at the coating start location of the paste patterns 23a to 23h of the paste patterns P1, P2, P3 and P4 using the data of the relative positional relationship table BPRPT and the relative positional relationship table MPRPT. A coating height of the nozzle 13a is then set based on the data of the coating condition of the vector data table MVDT. The setting of the coating height is to allow a distance between the discharge outlet of the nozzle 13a and a surface of the real substrate 22 to become a thickness of coated paste.

Furthermore, the coating start location of the paste patterns 23a to 23h can be set by modifying the position data of the relative positional relationship table BPRPT using the data of the relative positional relationship table MPRPT. For example, in the paste patterns 23a on the real substrate 22, assuming that the positional coordinates of the points A1 in the base pattern BP1 are (xa1, ya1) as

shown in Fig. 9(a) (these are registered with the relative positional relationship table BPRPT shown in Fig. 11 as the relative positions (Bx, By) for the number of the base data BD1) and a starting point location for the relative position data (Px, Py) for the pattern number P1 in the relative positional relationship table MPRPT shown in Fig. 12, i.e., 의 the starting point GBO for the real substrate 22 are (x1, y1), the coating start locations of the paste patterns 23a on the real substrate 22 are (x1 + xa1, y1 + ya1). However, the modified data can be stored in the RAM of the PC body 20, instead of the relative positional relationship table BPRPT and the relative positional relationship table MPRPT, as the coating start positional table, and the coating start locations of the paste patterns 23a to 23h can be set based on the data of the coating start positional table.

If the above process is finished, the servomotors 8a, 8b and 10 (Fig. 1) are driven based on the paste pattern data stored in the RAM of the microcomputer 17a (Fig. 2). Accordingly, in a state where the paste discharge outlet of the nozzle 13a is opposite to the real substrate 22, it moves in the X and Y direction according to the paste pattern data. While some air pressure is applied to the paste container box 13 from the positive pressure source 30 (Fig. 2), the paste discharge outlet of the nozzle 13a begins discharging paste.

Further, simultaneously with pattering of the paste pattern, the microcomputer 17a receives real data of a distance (a coating height) between the paste discharge outlet of the nozzle 13a and a surface of the real substrate 22 from the telemeter part 14, measures undulation on the surface of the real substrate 22, and then drives the servomotor 12 based on the measurement. Thus, a paste pattern is coated and patterned so that the height of the nozzle 13a from the real substrate 22 keeps constant.

As such, the paste pattern is coated and patterned. Whether to finish the coating and patterning operation of the paste pattern is determined depending upon whether the coating point is the end of the paste pattern to be coated, which is decided by the paste pattern data. If it is determined that the coating point is not the end of the paste pattern, the process returns to the process of measuring undulation on the surface of the real substrate 22. The paste coating operation is repeatedly performed until the coating point reaches the coating end of the paste pattern.

The coating operation of the paste pattern is performed on a n number of the whole set paste pattern data. If the coating point reaches the end of the paste pattern by means of paste pattern data of a last number n, the servomotor 12 is driven to raise the nozzle 13a and the paste pattern coating process (step 700) is then finished.

The process proceeds to a substrate exhaust process (step 800). In this process, in Fig. 1 adsorption of the real substrate 22 to the substrate adsorption plate 4 is released, and the substrate return conveyers 2a and 2b are raised and then moved on the real substrate 22. In this state, the substrate is exhausted out of the device body M by means of the substrate return conveyers 2a and 2b.

It is then determined whether the entire processes are finished (step 900). In the case where paste patterns are coated on a plurality of real substrates using paste pattern data, the process is repeatedly performed on other real substrates 22 beginning the substrate mounting process (step 500). After a series of these processes are performed on all the real substrates 22, the work is then finished (step 1000).

Further, in he embodiment, it has been described that the nozzle 13a is

moved and the substrate 22 is fixed. The present invention is not limited thereto, but the nozzle can be fixed and the substrate can be moved.

Furthermore, in the embodiment, it has been described that paste pattern data are set based on base data. However, data stored in an internal storage unit such as a hard disk (not shown) or an external storage medium such as a floppy disk of the PC body 20 can be read, the production is performed based on the data for which registration is finished, data for which registration is finished are modified and registered as new operating data again, the production is performed using the data, data are newly written on the part of the device body M, and data transmitted as production data can be modified. The data writing process can be performed more efficiently by means of a method in which data are read from the device body M, re-registered and reused.

Furthermore, in the event that coating is performed using a plurality of nozzles, the same setting can be performed every nozzle.

Furthermore, in the embodiment, a case where the four paste patterns P1 to P4 of the same shape are coated patterned on the same substrate 22, as shown in Fig. 5, has been described. However, a plurality of paste patterns having the same shape the other than one or four paste patterns can be coat and patterned.

Furthermore, in the embodiment, it has been described that the entire paste patterns P1 to P4 to be patterned have the same shape. It is to be understood that the present invention is not limited thereto, but paste patterns can have different shapes. For example, in the case where the paste patterns P1 to P3 are patterns having the same shape and the paste pattern P4 is a pattern having a different shape from the paste patterns P1 to P3, in Fig. 5, pattern data can be written for the paste patterns P1 to P3 using the basis pattern BP, as described

above, and an additional paste pattern can be written for the paste pattern P4. Even in this case, the pattern data are registered with the vector data table MVDT shown in Fig. 8 (R>8). Further, for instance, in the event that the paste patterns P1 and P2 are patterns having the same shape and the paste pattern P3 and P4 are patterns having the same shape although the shape of the paste pattern P1 and P1 is different from that of the paste pattern P3 and P4 in Fig. 5, pattern data can be written using the basis pattern BP, and then registered with the vector data table MVDT.

[Effect of the Invention]

As described above, according to the present invention, data of a paste pattern having a predetermined shape can be readily set.

[Description of Drawings]

Fig. 1 is a view showing the construction of a paste coating apparatus according to an embodiment of the present invention.

Fig. 2 is a view showing connection of an electrical system and an air system of the embodiment shown in Fig. 1.

Fig. 3 is a flowchart illustrating the entire process of a paste coating process of the embodiment shown in Fig. 1.

Fig. 4 is a flowchart illustrating a detailed example of a paste pattern data setting process of Fig. 3.

Fig. 5 shows a detailed example of a paste pattern coated on the substrate in the embodiment shown in Fig. 1.

Fig. 6 shows a detailed example of a basic pattern used in setting data of

the paste pattern shown in Fig. 5.

Fig. 7 shows a detailed example of a registration item table in setting data of the paste pattern shown in Fig. 5.

Fig. 8 shows a detailed example of a vector data table of a paste pattern, which is automatically set from the registration item table shown in Fig. 7.

Fig. 9 shows a detailed example of a table of positional coordinate data used to set base data of the basis pattern shown in Fig. 6.

Fig. 10 shows a detailed example of a vector data table of individual base patterns that constitute the basis pattern shown in Fig. 6, which is written on the basis of data of the positional coordinate table shown in Fig. 9.

Fig. 11 shows a detailed example of a relative positional relationship table for setting the positional relationship of individual base patterns that constitute the basis pattern shown in Fig. 6.

Fig. 12 shows a detailed example of the relative positional relationship table for setting the positional relationship on the substrate of the paste pattern shown in Fig. 5, which consists of the basis pattern shown in Fig. 6.

[Explanation on Numerals]

4: Substrate adsorption plate

5: θ -axis movement table

6a, 6b: X-axis movement table

7: Y-axis movement table

9: Z-axis movement table

13: Paste container box (syringe)

13a: Nozzle

14: Telemeter

17: Controller

18: Monitor

19: Keyboard

20: PC body

22: Glass substrate

MDT: Registration item table

BDT1, BDT2: Positional coordinate data table

VDT1, VDT2: Vector data table

MVDT: Vector data table

BPRPT: Relative positional relationship table

MPRPT: Relative positional relationship table